

THURSDAY, SEPTEMBER 2, 1875

THE SCIENCE COMMISSION REPORT ON  
THE ADVANCEMENT OF SCIENCE\*

WE now proceed to indicate the tenor of the evidence received by the Royal Commission on the last two heads under which they have classified that part of their inquiry which relates to the Advancement of Science.

III.—*The Assistance which it is desirable the State should give towards that object* [the promotion of Scientific Research.]

On this head the evidence is enormously voluminous, and it may be said to be practically unanimous in demanding a very great increase to the aid now given towards original scientific investigation and observation. In order to afford some idea of the general tendency of this mass of testimony, we cannot do better than summarise the extracts appended in their Eighth and Final Report to the recommendations of the Commission.

As to the general question, which must precede all others, whether the State should aid science, the Commission refers first, with great propriety, to the opinions of eminent statesmen on what is as much a problem of statescraft as a question of science.

The evidence of Lord Salisbury is emphatic :—

“Do you hold that the State may legitimately interfere in giving aid to the advancement of science?—I certainly do. It is a very orthodox doctrine to hold, and one which could be supported if necessary by quotations out of Adam Smith, the essence of the doctrine being, that the State is perfectly justified in stimulating that kind of industry which will not find its reward from the preference of individuals, but which is useful to the community at large.”

“The State has already, to a considerable extent, recognised, has it not, that duty; and there are a considerable number of scientific institutions supported more or less by the State?—No doubt the State, in the money that it gives, and has given in past times, to the best Universities, has recognised that duty.”

“There are the Observatory at Greenwich, the British Museum, and Kew Gardens; you would consider those as instances in which the State aids the promotion of science?—They would be all instances in point; and I do not apprehend that as to the abstract doctrine itself there has ever been any serious contest.” . . .

Lord Derby's evidence in favour of State aid to science is all the more weighty from the limitations by which he guards it :—

“I think there has been a very general consent amongst a large number of men of science who have been examined before this Commission that in the present state of science there are many branches as to which there is no probability of their being advanced to the degree to which they are capable of being advanced by private effort, and without the assistance of State funds in some shape; what is your lordship's opinion upon that subject?—I am, as a general rule, very strongly in favour of private effort, and very decidedly against the application of State funds to any purpose that can be accomplished without them; but I think that if there is any exception to that which I venture to call a sound and wholesome rule, it is in the case of scientific research, because the results are not immediate, they are not popular in their

character, and they bring absolutely no pecuniary advantage to the person engaged in working them out. A great mathematical or a great astronomical discovery is a benefit to the whole community, and in a certain sense to mankind in general; but it is productive of absolutely no benefit, in a pecuniary point of view, to the person who has given his labour to it.”

Sir Stafford Northcote thus states his opinion on the point :—

“ . . . The State should do what it can both to promote scientific education and also to assist in the prosecution of scientific experiments and inquiries when they can be best prosecuted by the aid of the State.”

It is a matter of congratulation that these opinions, though expressed when out of office, are held, and will doubtless be maintained, by three of the foremost members of Mr. Disraeli's Cabinet. Nor can we forget that the Premier himself some time ago forcibly descanted on the extreme value of sanitary science, or that the Home Secretary, who has laboured so zealously in many departments of social reform, reminded the House of Commons, during the late session, that the proper method of paving and cleansing our wretched London streets really involved difficult scientific problems, at present neglected, and with nobody to undertake their solution.

The Commissioners observe that “on the proposition that it is the duty of the State to encourage original research they might multiply their extracts from the evidence indefinitely,” and they refer to the scientific testimony of Dr. Frankland, Sir W. Thomson, Dr. Joule, Mr. Gore, Dr. Carpenter, Prof. A. W. Williamson, Mr. Reed, Sir E. Sabine, Dr. Siemens, Dr. Sclater, Mr. Farrer, Admiral Richards, and numerous others, to show that the aid of Government to scientific research has been beneficial, so far as it has gone, but that it has been insufficient and should be increased; and as representing the opinions of public servants occupying high official positions in Government departments, they refer to the evidence of Admiral Richards, late Hydrographer of the Admiralty, and to that of Mr. Farrer, Secretary to the Board of Trade.

The broad general principle that the State should aid original research, and that it at present does so insufficiently, being established, the next question is in what direction is additional aid required? The evidence on this question is classified by the Commissioners under the heads Laboratories, Physical Observatories, Meteorology, Tidal Observations, the Government Grant administered by the Royal Society, and Payment of Scientific Workers.

*Evidence relating to the Establishment of Laboratories.*—Amongst the witnesses who are in favour of the erection of new laboratories for research is Colonel Strange, whose view of the national requirements in these respects is thus given :—

“Will you be so good as to enumerate the institutions which you think should be under the State?—(1) an observatory for physics of astronomy; (2) an observatory for terrestrial physics, namely, meteorology, magnetism, &c.; (3) a physical laboratory; (4) an extension of the Standards Office; (5) a metallurgical laboratory; (6) a chemical laboratory; (7) an extension of collections of natural history, and an able staff of naturalists; (8) a physiological laboratory; (9) a museum of machines, scientific instruments, &c. I believe that under one or

\* Continued from p. 285.

other of these and existing institutions every requisite investigation will range itself. I have not stopped to inquire whether one or another is more or less important. My aim in the spirit of my postulate No. 2\* has been *completeness*. It may be necessary for a manufacturer to prosecute only such particular investigations as promise direct and speedy profit. A great nation must not act in that commercial spirit. All the operations of nature are so intimately interwoven, that it is impossible to say beforehand that a given line of research, apparently unproductive, may not throw light in unsuspected directions, and so lead to untold and undreamt-of treasures." . . .

Sir W. Thomson's evidence is as follows :—

"Are you of opinion that any national institutions supported by the Government are required for the advancement of science?—I think that there ought to be institutions for pure research supported by the Government, and not connected with the Universities. The only suitable place at present for such institutions would be London, or the neighbourhood of London; in that situation, I believe, very great things could be done by institutions for pure research, at which work of a very great immediate money value would be produced at an extremely moderate cost, and I believe that discoveries redounding to the honour and credit and pleasure of this country would infallibly be made."

"Are you able to give any idea as to how many such institutions would be required?—There should be five. One at present exists, namely, the Royal Observatory at Greenwich. Another in my opinion is very much wanted, an observatory for astronomical physics, then again a physical laboratory, and a laboratory for chemical research, and a physiological laboratory are necessary." . . .

"Would such a physical laboratory differ in any essential respects from a physical laboratory attached to an University?—Yes; it would be adapted solely for research, with no provision for pupils except what may be called apprentices, or pupils for research; no provision for teaching the mere elements of manipulation, but provision for researches directly adapted to increase knowledge, and for making pattern researches for the sake of training research pupils who had already gained experience and proved ability in institutions of instruction."

"Would you leave the researches to be carried on at such a laboratory mainly to the discretion of the person who had charge of it, or would you place it in any degree under the control of the council of which you have been speaking?—I would leave it to the discretion of the person who has charge of it." . . .

"And that the Government should also be able to command investigation on the advice of the council?—Yes."

"Of course the director would report?—Yes, the director would report on everything, both researches undertaken at his own instigation, and investigations undertaken for the council or for the Government."

"And your view of what should be done in the chemical and physiological laboratories would, I presume, be something of the same nature?—Yes, something of the same kind, *mutatis mutandis*."

"With respect to the apparatus, and the annual supply of apparatus, it is probable, is it not, that the physical

laboratories would be the most costly?—Yes, the most costly in apparatus."

"Some very fine instruments of a costly kind are now required in physiological inquiries, and large pieces of apparatus are sometimes employed, such as the respiration apparatus at Munich, which was put up on the recommendation of Prof. Pettenkofer?—Yes, it would be in my opinion necessary not to limit to a fixed endowment the expenditure of any one of those institutions, but to let it be determined (if I may use the expression once more) by natural selection; applications for money to be made to the council to be duly weighed, and the council to apply to the Treasury. That would be much more economical than giving a fixed sum which, being to be spent, might be spent without due regard to economy, or which, on the other hand, might prove to be insufficient for valuable researches, causing the institution thereby to be crippled and to lose efficiency."

"You would not think it indispensable, would you, that such institutions, if the Government thought fit to establish them, should be in the heart of London, or in any very central situation?—No; it would be much better that they should be in the country in positions conveniently accessible to London." . . .

"You would not institute any regular provision for teaching in those laboratories?—No."

"But you would allow young men or students who wished to carry out original research to avail themselves of them under the direction of the persons who were in charge of them?—Yes, under the direction, and to some degree under the instruction of the persons in charge; but the instruction should be limited to methods for advancing science. The director of such an institution must not be occupied with lecturing in any other institution, or with lecturing at all. He ought indeed to be prohibited from lecturing, except one or two occasional lectures in the course of a year."

"You think that the object for which you recommend the establishment of those laboratories could not be accomplished by any other means—not by investigations carried on in other laboratories in the country?—Certainly not by any other means."

Dr. Frankland thus refers to the double function which such laboratories might perform, and states his view in reference to their management :—

"Can you make any suggestions as to stimulating original research in this country?— . . . We have in this country a considerable body of investigators who are not engaged in teaching at all, and I think that this is a peculiarly hopeful feature of our case. It shows that the English have not only a taste for research, but that they have a natural talent for it. We have numerous men like Mr. Gassiot, Sir W. Grove, Dr. De la Rue, Mr. Spottiswoode, Mr. Huggins, Mr. Duppa, Mr. Buckton, Mr. Joule, Mr. Lockyer, Mr. Perkin, Mr. Schunck, Col. Yorke, and others whom I could name, who are not in any way engaged in teaching, and never have been, but who have made important original researches, and have spent a good deal of their time in the working out of new discoveries. Now that method of stimulating research which I have mentioned in my former examination would not of course apply to them. Men of this class are really peculiar to England, for I have never known any such instance in Germany or in France, of men altogether disconnected with teaching taking up research in the way it is done in England. I think that for such men the establishment of national institutions such as those which are recommended by Col. Strange would be peculiarly useful. In fact, I have heard several of these gentlemen express strong opinions as to the great advantage it would be to them if they could go to some institution of that kind to conduct research, where expensive instruments, which are often required for their experiments, were provided for a

\* Col. Strange opened his evidence before the Royal Commission in the following terms :—

"I can hardly do better than by stating the four postulates on which I base all my recommendations: it seems to me indispensable that I should state the basis upon which I am about to speak. Those postulates are as follows:—(1) That science is essential to the advancement of civilisation, the development of national wealth, and the maintenance of national power. (2) That all science should be cultivated, even branches of science which do not appear to promise immediate direct advantage. (3) That the State or Government, acting as trustees of the people, should provide for the cultivation of those departments of science which, by reason of costliness, either in time or money, or of remoteness of probable profit, are beyond the reach of private individuals; in order that the community may not suffer from the effect of insufficiency of isolated effort. (4) That to whatever extent science may be advanced by State agency, that agency should be systematically constituted and directed."



number of such investigators, and where appropriate rooms for carrying on these researches could be had. It is exceedingly difficult to carry on chemical research in one's own house, because of the want of proper contrivances for dealing with corrosive gases and vapours; and hence appropriate buildings ought to be provided for carrying on such investigations. I think, therefore, that it would afford a great stimulus to research of this kind if such institutions were provided, and furnished with such instruments as would be generally useful in research, leaving the more special instruments and materials adapted to the particular researches themselves, to be provided by each operator. . . . I have reason to believe that no inconsiderable number of men, more especially of those educated in some of the science schools, would undertake researches if such facilities were afforded them."

"Would you consider the chief use of such institutions as laboratories to be to enable private inquirers to carry on their researches, or would you propose that any investigations should be carried on there on behalf of the State?—I think that both things might be provided for. The State requires many important investigations to be carried on. . . . That might well form one part of the objects of such a building, but I should think that so far as abstract research, of which we are more especially speaking now, is concerned, the other portion of those objects, namely, the encouragement of original investigation in the case of amateurs would be more important, because the investigations made for the Government are essentially practical investigations; they are not usually of that character which lead to discoveries or to the advancement of science."

"Would you place those laboratories under a permanent official?—They must of necessity be under the direct and constant superintendence of some one thoroughly conversant with the operations going on in them; and, so far as the conducting of the separate original researches is concerned, I think that it would be very desirable that the admission into such institutions should be granted through some such body as the Research Fund Committee, for instance, of the Council of the Royal Society, or some body of that kind, who would make intelligent and impartial inquiry into the qualifications of the men applying for accommodation."

"You would not throw upon the director the sole responsibility of deciding who should be admitted and who should not?—I think that would not be desirable." . . .

"And do you think it would be requisite that those institutions should be on a large scale?—I think that they ought to be on a fairly large scale even to begin with, because it is always a costly process to rebuild such institutions; and I am inclined to think that they would be rapidly filled. A tolerably large institution of that kind would probably in a very few years be filled with workers." . . .

"You would not recommend, in the first instance, at least, more than the establishment of one for each department of science?—I think not more than that."

"And should it be in London?—Yes, I suppose they must be commenced here, but eventually it would be desirable that the important centres in the provinces should also be furnished with such places."

"Col. Strange recommended the establishment of four laboratories; should you be disposed to agree with him in that view?—Yes, I think that those would be necessary; perhaps the least essential of them would be the metallurgical one, but certainly the others would be quite essential."

Mr. Warren De la Rue, whose opinion on this subject, as that of one of the most eminent private scientific workers on a large scale, must have peculiar weight, expresses himself as follows:—

"Are you of opinion that any new institutions in the way of laboratories should be established by the State?—I hold it to be so important that chemistry should be extensively cultivated in England, that I would strongly advocate that there should be a State laboratory. That State laboratory should undertake all the chemical work which the Government might require, but at the same time, according to the views which I hold, it ought to be such an establishment as could afford facilities to men who have completed their scientific education, and who might be desirous of continuing original investigations, in which space for working and instruments should be afforded them; and, moreover, if men were not in a position of fortune to continue their researches, in some cases materials and even money might be granted to them on the recommendation of the council. I may state that of my own knowledge I know that chemical science at present is not progressing in England in a satisfactory manner, that we do not make so many original researches as our continental neighbours, particularly the Germans, do. In Germany very great patronage is given to science, magnificent laboratories have been built, and the students, who, after they are sufficiently advanced, are encouraged to make original investigations, contribute at present most largely to scientific chemistry."

"Do you think that the establishment of those Government laboratories would be likely to give rise to complaints from any existing institutions?—I think not, if those Government establishments were not educational establishments. . . . What I contemplate is merely that facilities should be given to men who have already been educated, and not to interfere at all with the functions of educational establishments."

"Do you think that any other laboratories would be needed?—I attach the greatest importance to a chemical laboratory, because I believe that chemistry is destined to play a very important part in the advancement of the arts in all civilised countries, but there also ought to be a physical laboratory very much on the same footing as the chemical laboratory, and in which facilities should be afforded for conducting physical investigations."

"You would give admission to those laboratories on the same principle as to the chemical laboratories?—Yes, to men who could show that they were qualified to make a beneficial use of them."

"You think that any investigations required by the State should also be conducted there?—Yes, they should be conducted in either the chemical or physical laboratory, according to the nature of the investigations. For example, there were a great number of investigations carried on at Woolwich relating to the strength of different alloys whose chemical composition was determined by analysis. Such investigations would be very well conducted in the chemical laboratories."

"Would you transfer the work now done at Woolwich to such a laboratory?—Part of the work, but I would except such special work as could be better done at each of the Government establishments. Special investigations would fall within the duties of the central government laboratory. The testing of the purity of the products to be used in the department and routine work would be better conducted in those establishments."

"With respect to the other purpose of the laboratory, do you think that there would be a sufficient number of independent inquirers to occupy an establishment like that?—I think that there would be a great number of men who would be very glad to avail themselves of such opportunities as a laboratory of that kind would afford, and their doing so would not add materially to the cost of the establishment."

Mr. Gore, a distinguished practical chemist, also recommends the establishment of laboratories, his evidence being essentially of the same purport as that quoted above.

The great bulk of the evidence, in fact, on this part of the question is to the same effect; and it has not been neutralised, in the judgment of the Commissioners, by other views expressed by a small number of distinguished witnesses.

Amongst the latter Dr. A. W. Williamson thinks that the development of schools would be preferable to the establishment of laboratories. His views however do not seem to be fully matured; the following extract from his evidence showing that though more in favour than perhaps anyone else of equal authority, of combining school instruction with original research, he still perceives that some independent provision for the latter might be desirable. He says:—

"At the same time it is quite possible that, in exceptional cases, research might with advantage be carried on in separate places; but I should always view with regret, as a waste of resources, the separation of that higher work of research from the more humble work of teaching, which naturally belongs to it. They help one another, and I think that each would lose from being separated from the other; still, in some cases, it might possibly be advisable."

Dr. Siemens, on the other hand, apprehends that the establishment of Government laboratories, which, amongst other functions, should be accessible to private workers, might cause disappointment to some who might not be able to gain access to them, and that there might be favouritism and want of discrimination in the dispensing of the privileges in question.

Dr. Burdon Sanderson would rather see increased facilities given to the great schools of medicine for the prosecution of physiological research, than laboratories of an independent character established. He questions whether we have at present a sufficient number of trained workers to use establishments of the latter kind; whilst Lord Salisbury is doubtful whether by any moderate expenditure of funds we could provide an expensive class of scientific instruments of all kinds for all the persons who might be inclined to use them.

The Commissioners, after fairly balancing the views laid before them, sum up this question in their final conclusions, as follows:—

"More complete means are urgently required for scientific investigations in connection with certain Government departments; and physical as well as other laboratories and apparatus for such investigations ought to be provided."

(To be continued.)

#### IRBY'S BIRDS OF GIBRALTAR

*The Ornithology of the Straits of Gibraltar.* By Lieut.-Col. L. Howard L. Irby, F.Z.S., &c. (London: R. H. Porter, 6, Tenterden Street; Dulau and Co., Soho Square, 1875.)

**H**ERCULES, as in our schooldays we used to be told, once took the trouble of cleaving asunder the isthmus which in his time, whenever that was, joined Europe and Africa. Colonel Irby has been at the pains of reuniting the two continents, not indeed actually, but for the purposes of his work; and has thus undone, so far as ornithology is concerned, the labour of the demigod. Though we certainly have no fault to find with the exploit which gave the waters of the Atlantic access to

the Mediterranean basin, and fully admit the advantage which has thereby accrued to most European nations, and to our own in particular, it must be confessed that we deem more highly the feat of our modern hero than the prowess of him of antiquity.

It is now some years since all authorities have recognised the fact that, if socially Africa begins, as the satirical statesman said, at the Pyrenees, Europe does not biologically end at the Strait of Gibraltar; and the readers of NATURE do not need reminding that between the animal and vegetable products of either side of that narrow channel there is little essential difference. Thus the southern part of Andalucia and the northern part of Morocco form a very homogeneous district to come under the survey of an observant ornithologist perched upon the rocky heights of "Old Gib." Such an observant ornithologist Col. Irby has proved himself to be, as might indeed have been expected of him, when we remember that he was one of the few officers of the now ancient Crimean time who was sufficiently undisturbed by war's alarms to follow his pursuits over the steppes of the Tauric Chersonese, and again, when called not long after to India, in days yet pre-Jerdonian, did not intermit his occupations in Oudh and Kumaon for all that rebellion, if not something more, was still rife in those districts.

We have seldom had the pleasure of reviewing a more engaging and more unpretending book than that which is now before us. It is by one who shows himself in almost every page to be a thorough field-naturalist, and a field-naturalist of the best kind. Cherishing with pardonable pride, as a man should do, his own observations, he can yet believe that those of others may likewise have some merit, and thus he gives us an admirable account of the place of his choice, though, as he modestly remarks, "there is ample room for anyone with energy to work out a great deal more information on the birds of the Straits." Nearly all that he has to say about those of the Spanish side is from his own personal knowledge, acquired during a more or less prolonged stay at "the Rock," between February 1868 and May 1872, and again from February to May 1874, but including in this time only one summer. "For the first three years of my residence at Gibraltar," he says, "I was quartered with my regiment, the remaining time being passed there chiefly with a view to ornithological pursuits, from time to time making excursions, generally of about a fortnight's duration, to some part or other within the districts above mentioned, but chiefly confining my attentions to the country within a day's journey of Gibraltar." The observations on the Moorish birds are in great measure culled from the manuscript of the late François Favier, a French collector well-known to many ornithologists in England, who died in 1867 after a residence of more than thirty years at Tangier. This manuscript our author secured at a high price,\* to find indeed, "amidst a mass of bad grammar, bad spelling, and worse writing, which cost many hours to decipher, that it did not contain so much information as I had reason to anticipate, a good deal of the matter having been copied from other authors;" and, we may add, not copied with much discrimination.

The remaining materials of which the Colonel has

\* This manuscript, or possibly an older one of which it is a corrected copy, was seen at Tangier in 1844 by Wolley. Colonel Irby has lately presented it to the Zoological Museum of the University of Cambridge.